Annals of Physics 342 (2014) 11–20

Contents lists available at ScienceDirect

Annals of Physics

journal homepage: www.elsevier.com/locate/aop

Self-interaction in the Bopp–Podolsky electrodynamics: Can the observable mass of a charged particle depend on its acceleration?

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HIGHLIGHTS

- An expression for the self-force in the Bopp–Podolsky electrodynamics is given.
- For a uniformly accelerated charged particle an explicit formula for the self-force is obtained.
- Dependence between the observable mass of a charged particle and its acceleration is found.

ARTICLE INFO

Article history:
Received 3 September 2013
Accepted 7 December 2013
Available online 12 December 2013

Keywords:
Self-force
Generalized electrodynamics

ABSTRACT

In this paper we obtain the expression for the self-force in the model with the Lagrangian containing additional terms, quadratic in Maxwell tensor derivatives (so-called Bopp–Podolsky electrodynamics). Features of this force are analyzed for various limiting cases. When a charged particle moves along straight line with a uniform acceleration, an explicit formula is found. In the framework of the considered model, an observable renormalized particle mass is shown to depend on its acceleration. This dependence allows, in principle, to extract experimentally a value of the particle bare mass.

1. Introduction

Effects of the quantum field theory in the low-energy limit can be described by the action functional with an effective Lagrangian, which contains additional nonlinear terms and terms with higher derivatives. Furthermore, in recent years the dark energy problem and the accelerated expansion of the Universe have inspired an interest in the various phenomenological models in cosmology,

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0003-4916/$ – see front matter
http://dx.doi.org/10.1016/j.aop.2013.12.005